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Improvements in and relating to refrigeration apparatus

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(71) Applicant(s)
Alexander Theakston

(54) Inventor(s)
Alexander Theakston

COMMONWEALTH OF AUSTRALIA

Patents Act 1952

APPLICATION FOR A PATENT

I, ALEXANDER THEAKSTON, an Australian citizen, of 64 Ely Street, Revesby, New South Wales, 2212, Commonwealth of Australia hereby apply for the grant of a Patent for an invention entitled:

IMPROVEMENTS IN AND RELATING TO REFRIGERATION APPARATUS

which is described in the accompanying provisional specification.

My address for service is:-

H.R. HODGKINSON & CO
Patent and Trade Mark Attorneys
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Dated this 4th day of May 1988.

ALEXANDER THEAKSTON

BY: H R Hodgkinson

Patent Attorney for the Applicant

To: The Commissioner of Patents
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PATENT

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DECLARATION IN SUPPORT

OF AN APPLICATION OR A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Application made by ALEXANDER THEAKSTON

for a patent/~~patent of addition~~ for an invention entitled: IMPROVEMENTS IN AND RELATING TO REFRIGERATION APPARATUS

I, ALEXANDER THEAKSTON

~~care of the applicant company~~ do solemnly and sincerely declare as follows:.

*a(1) I am the applicant for the patent/~~patent of addition~~.

*a(1) ~~I am authorised by the applicant for the patent/patent of addition to make this declaration on its behalf.~~

*b(2) ~~The basic application(s) as defined by section 141/142 of the Act was/were~~ made

in on

in on

in on

~~by~~

*a(3) I am the actual inventor of the invention.

*a(3)

~~is/are the actual inventor(s) of the invention and the facts upon which~~

~~is/are entitled to make the application are as follows:~~

*b(4) ~~The basic application(s) referred to in paragraph 2 of this Declaration is/are the~~ first application(s) made in a ~~Convention country~~ in respect of the invention the ~~subject of the application~~.

Declared at [illegible] this [illegible] day of [illegible] 19 89

A. Theakston

Alexander Theakston

~~Status~~ .....

To: The Commissioner of Patents,
Commonwealth of Australia.

*a – Delete whichever is inapplicable
*b – Delete if not a Convention application.
No legalisation is required.

H. R. HODGKINSON & CO.
Patent Attorneys,
Sydney.

(12) PATENT ABSTRACT (11) Document No. AU-A-33985/89
(19) AUSTRALIAN PATENT OFFICE

(54) Title
IMPROVEMENTS IN AND RELATING TO REFRIGERATION APPARATUS

(51)[4] International Patent Classification(s)
F24J 002/00 F24J 002/32 F25B 015/04

(21) Application No. : 33985/89 (22) Application Date : 04.05.88

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(60) Related to Provisional(s) : PI8127

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(57) Claim

The present invention sets out to provide refrigeration apparatus and a refrigeration system, whereby refrigeration is able to take place in a relatively straightforward and efficient manner, in areas where fuel and electricity are unavailable or unduly expensive. Further, and referring to one preferred form of the invention, because the invention will be used mostly in hot climates, where for example condensation of a refrigerant will be relatively difficult, a loop such as for example a superheat loop may be incorporated into the discharge of a reversible still/absorber feature, in order to raise or increase the discharge temperature of the refrigerant, so that condensation can more easily occur at elevated ambient temperatures.

In a further form of the invention, as will be described by way of example only, and given that solar heat is used to operate the apparatus, cloud cover may from time to time prevent sufficient energy from being absorbed from the sun. Thus, secondary heat sources can be provided, to be incorporated into the solar heat loop, whereby additional heat derived from simple fuels such as for example wood, or waste heat from another process, may be utilised.

In a preferred form of the invention a binary refrigerant mixture of ammonia and water is used, in portions desired or predetermined as being appropriate, although it should be appreciated that this is by way of example only and that the invention is not limited to the use of a binary mixture of ammonia and water.

1. A refrigeration apparatus including means to allow said apparatus to be operated by solar energy; and including refrigerant in the form of a suitable binary mixture the arrangement being adapted such that in use refrigerant will be distilled off from said binary mixture as a result of solar energy in the form of heat, during daylight hours; means being provided so that during cooler ambient temperatures of the night, intermittent absorption refrigeration occurs.

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COMPLETE - AFTER - PROVISIONAL

SPECIFICATION

(ORIGINAL)

	Class	Int. Class
Application No :		
Lodged :		
Complete-After-Provisional Specification Lodged :		
Accepted :		
Published :		
Priority :		
Related Art :		

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Actual Inventor	:	ALEXANDER THEAKSTON
Address for Service	:	H.R. HODGKINSON & Co Patent & Trade Mark Attorneys 26a Alfred Street MILSONS POINT N.S.W. 2061

Complete-After-Provisional Specification for the invention entitled:

IMPROVEMENTS IN AND RELATING TO REFRIGERATION APPARATUS

The following statement is a full description of this invention including the best method of performing it known to me:-

S007177 03/05/89

THIS INVENTION relates to refrigeration apparatus and in particular to apparatus which is adapted to be operated, in a preferred form of the invention, by solar heat energy.

Up until this time various forms of refrigeration apparatus have been known and used, however there has been no known refrigeration apparatus which has successfully and efficiently allowed for operation primarily by solar power or heat, and which is of straightforward and efficient construction, such as to be capable of being used in third world countries, and in remote areas where for example electicity and fossil fuels are either unavailable or uneconomic from a supply point of view.

It is therefore an object of this invention to go at least some way towards overcoming or minimising these problems.

It is a further object of this invention to provide a straightforward and efficient refrigeration apparatus.

Other objects of this invention will become apparent from the following description.

According to one aspect of this invention there is provided a refrigeration apparatus, and including means to allow said apparatus to be operated by solar energy; including refrigerant in the form of a suitable binary mixture the arrangement being adapted such that in use refrigerant will be distilled off from the binary mixture as a result of solar energy in the form of heat, during daylight hours, and means being provided so that during the cooler ambient temperatures during night, intermittent absorption refrigeration will occur.

According to a further aspect of this invention there is provided a refrigeration apparatus, and including means to allow said apparatus to be operated by solar energy;

including refrigerant in the form of a suitable binary mixture the arrangement being adapted such that in use refrigerant will be distilled off from the binary mixture as a result of solar energy in the form of heat, during daylight hours, and means being provided so that during the cooler ambient temperatures during night, intermittent absorption refrigeration will occur; and wherein secondary cooling during the daylight hours is achieved by incorporation and use of secondary absorption refrigeration circuitry.

The present invention sets out to provide refrigeration apparatus and a refrigeration system, whereby refrigeration is able to take place in a relatively straightforward and efficient manner, in areas where fuel and electricity are unavailable or unduly expensive. Further, and referring to one preferred form of the invention, because the invention will be used mostly in hot climates, where for example condensation of a refrigerant will be relatively difficult, a loop such as for example a superheat loop may be incorporated into the discharge of a reversible still/absorber feature, in order to raise or increase the discharge temperature of the refrigerant, so that condensation can more easily occur at elevated ambient temperatures.

In a further form of the invention, as will be described by way of example only, and given that solar heat is used to operate the apparatus, cloud cover may from time to time prevent sufficient energy from being absorbed from the sun. Thus, secondary heat sources can be provided, to be incorporated into the solar heat loop, whereby additional heat derived from simple fuels such as for example wood, or waste heat from another process, may be utilised.

In a preferred form of the invention a binary refrigerant mixture of ammonia and water is used, in portions desired or

predetermined as being appropriate, although it should be appreciated that this is by way of example only and that the invention is not limited to the use of a binary mixture of ammonia and water. Other suitable agents and compounds may be used. The invention will however be described by way of example only with reference to a binary mixture of ammonia and water, and with reference to the accompanying drawing wherein:

FIGURE 1 is a diagramatic and schematic view of a refrigeration apparatus and system according to one form of the present invention.

Referring now to Figure 1 of the drawings, the system is provided with a generator/absorber, in the form of vessel 1, which is preferably a pressure vessel covered or sheaved in appropriate thermal insulation. An evaporator is provided and shown as vessel 12, this preferably being a pressure vessel housed in an insulated space such as for example a cool room or a refrigerated cabinet. Preferably the evaporator in the form of vessel 12 has an outer shell which is formed so as to have the function of a refrigerant receiver/evaporator. An inner cylinder 13 in the form of the freezing chamber is also provided, which may be used for example as a brine tank for continuous cooling purposes or for example as an ice maker.

The generator/absorber 1 holds and contains a charge of the binary mixture of ammonia and water, and this charge is heated by solar heated fluid from a solar absorber 10 by way of a thermosyphon circuit through heat exchanger means 19. The generator mixture preferably vaporises into conduit 2, which is in intimate and juxtaposed contact with the generator shell, so as to result in the generated vapour being heated to the shell temperature. This has been found to be necessary as the generated vapour tends to cool adiabatically as it is released from the mixture. This

would normally result in the vapour having difficulty in rejecting sufficient heat to condense freely, particularly at high ambient temperatures using air cooled condensers.

The hot vapour is then transported by way of a loop, such as for example a hairpin loop, to a water seal, such as in a well known, or suitable manner. Partially stripped vapour from a trap 3, then passes through a rectifier 4 and then through condenser 5 where the resultant liquid refrigerant is held in liquid seal 6, and where a heat exchanger sub cools the refrigerant, to be passed into flooded evaporator 12.

During night, and thus during a cooling phase, as the absorber 1 cools, vapour such as ammonia vapour is drawn off the evaporator vessel 12, cooling the retained ammonia liquid in the evaporator, to be returned to the absorber 1 by way of conduits 5 and 4, thereafter to pass into the absorber heat exchanger 9, completing the refrigeration cycle. In the preferred form of the invention conduit 7 drains the evaporator of residual water, such as carried over during the previous heating phase, in a suitable or known manner.

It will be appreciated that in the present invention cooling is substantially effected only during night, or during non daylight hours, using an intermittent refrigeration system. Thus, brine tank 13 is incorporated into the evaporator 12 to hold the refrigerated space surrounding the evaporator at a relatively low temperature during daylight heating hours.

Thus, at this stage ambient temperatures are at their highest and warm condensed refrigerant, being fed into the evaporator, combines to raise the brine temperature at a comparatively high rate. Thus, a supplementary continuous absorption refrigeration system can be incorporated into the

present apparatus and system, in order to give a cooling effect to the evaporator and incoming condensed ammonia.

In a preferred form of the invention the refrigeration apparatus and system uses a further component in the refrigerant absorber mixture, being an inert gas, using partial pressure techniques which are appropriate and well known. In the preferred form of the invention and by way of example only, the inert gas may be hydrogen.

In use, some solar heat absorbed from the collector or source 10 is rejected into generator 14, prior to being taken up into heat exchanger 19. Vapour is formed from the heated water/ammonia binary mixture, and is liquified in the condenser 15, to thereafter evaporate and cool in evaporator 16, from where absorber vessel 17 will draw the ammonia gas to be absorbed in the heat exchanger 18. A loop may feed the reconcentrated water/ammonia binary mixture back to generator 17 to complete the cycle.

In the preferred form of the invention evaporator 16 will thus act to cool both the main flooded evaporator 12 and the incoming condensed ammonia by heat exchange.

The solar absorber 10 used in the present invention may be of any appropriate form, but in one form of the invention is of an evacuated tube formation, having a concentrator as shown in the accompanying drawings, capable of heating fluid to approximately 100oC above ambient. The heat exchanger 11 may be used as a supplementary heating source, should the solar heating be below quality and may be heated directly by known means such as for example waste heat, fuel or the like.

It should be appreciated that the present invention allows for the absorption pressure vessels and pipework to be constructed of an appropriate material such as for example

mild steel, which has a relatively long life expectancy, when using the fluid described by way of example.

General design criteria for the components of the present invention allow in one form, for the components of the intermittent absorption refrigeration system, to be in relatively open communication with each other, preferably using no extra mechanical valves such as check valves and the like, so that the apparatus can run automatically preferably without the need of an operator and with minimal maintenance. This is particularly advantageous from a cost point of view, insofar as material and labour costs are concerned.

In one form of the present invention design criteria for the refrigeration circuitry may be substantially the same as that for unfired pressure vessels, whilst standards of welding, fittings and pipework will depend upon inside diameters of components and maximum pressures to be contained.

Pressure vessels for use in the present invention may be rolled to a predetermined or desired size. Alternatively, or in addition thereto, appropriate or suitable large diameter pipes may be selected with suitably designed end plates, welded into position, and used as the pressure vessels.

Heat exchangers such as the heat exchangers 2, 6 and 16 shown in the accompanying drawing, may be conduits welded to each other or to the shell of the related pressure vessel, to effect simple heat exchange. Other forms of heat exchangers may however be used if desired.

It should be appreciated that in the present invention, the intermittent absorption system and supplementary unit, if needed and used, are so arranged to avoid the need for

valves or mechanical equipment needing attention. This then provides the advantages outlined and referred to above.

It should be appreciated that the present invention has been described by way of example only and that improvements and modifications may be made thereto without departing from the scope or spirit thereof as defined by the appended claims.

THE CLAIMS DEFINING THIS INVENTION ARE AS FOLLOWS:

1. A refrigeration apparatus including means to allow said apparatus to be operated by solar energy; and including refrigerant in the form of a suitable binary mixture the arrangement being adapted such that in use, refrigerant will be distilled off from said binary mixture as a result of solar energy in the form of heat, during daylight hours; means being provided so that during cooler ambient temperatures of the night, intermittent absorption refrigeration occurs.

2. A refrigeration apparatus including means to allow said apparatus to be operated by solar energy, including refrigerant in the form of a suitable binary mixture, the arrangement being adapted such that in use, refrigerant will be distilled off from said binary mixture as a result of solar energy in the form of heat, during daylight hours; means being provided such that during cooler ambient temperatures of night, intermittent absorption refrigeration will occur; secondary absorption refrigeration circuitry being provided to allow for secondary cooling during daylight hours.

3. A refrigeration apparatus as claimed in Claim 1 or Claim 2, including a binary refrigerant mixture of ammonia and water.

4. A refrigeration apparatus as claimed in any one of the preceding claims, including means to raise or increase discharged temperature of said refrigerant, such that condensation may more easily occur at elevated ambient temperatures.

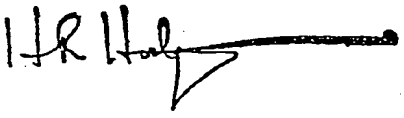
5. A refrigeration apparatus as claimed in any one of the preceding claims, including a secondary heat source.

6. A refrigeration apparatus as claimed in Claim 1 or Claim 2, further including supplementary continuous absorption refrigeration means, adapted and used to produce a cooling effect to a prime evaporator.

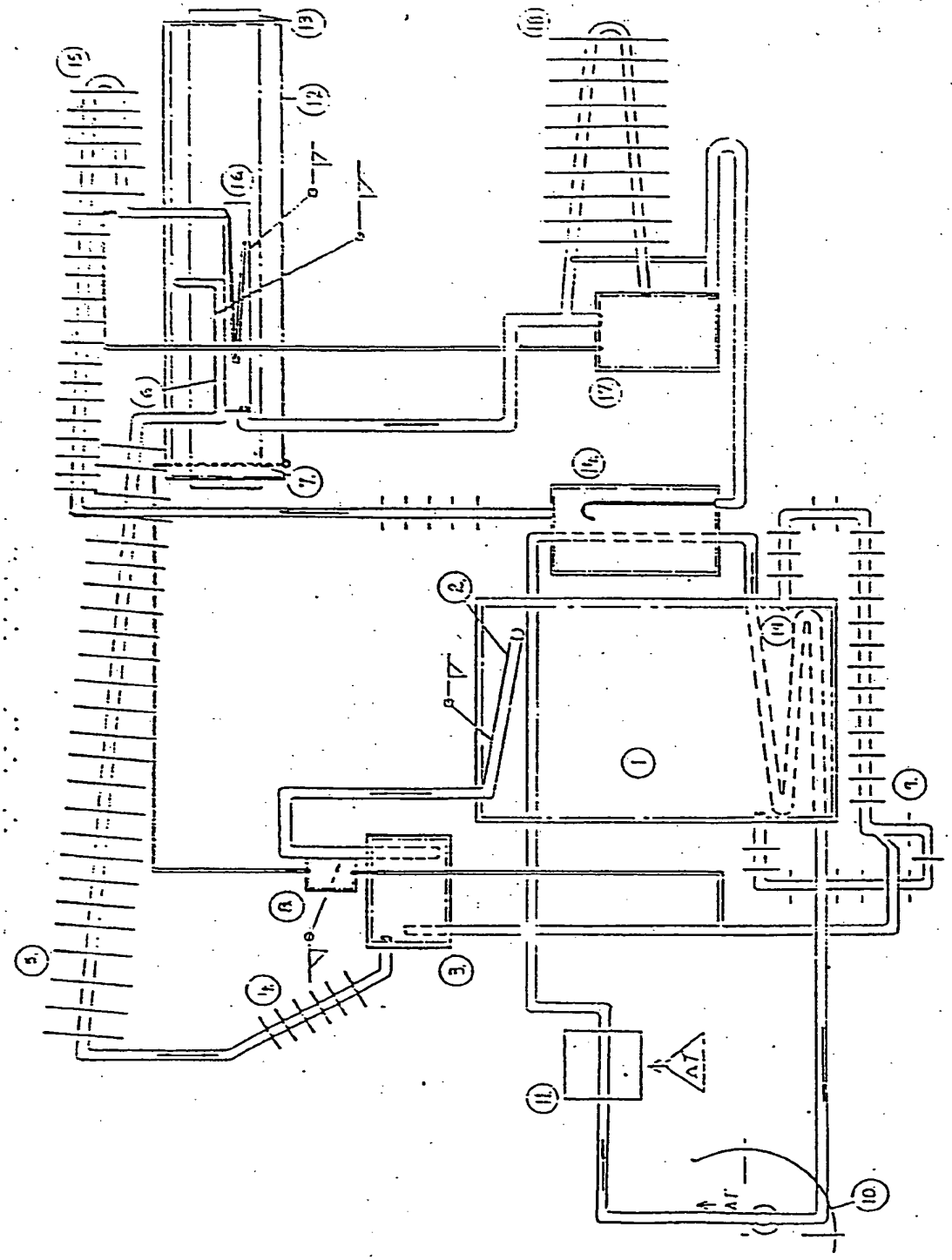
7. A refrigeration apparatus as claimed in Claim 1 or Claim 2, with reference to the accompanying drawings.

Dated this 2nd day of May 1989

ALEXANDER THEAKSTON

BY: 

H.R. HODGKINSON & CO.
Attorneys for the Applicant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